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Research Article

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Determination of the Biogas Potential from Animal Waste; Tekirdag City Example

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Abstract Renewable energy has gained great importance with increasing population. Animal husbandry is becoming increasingly important in the Thrace region. For this reason, there is a potential for biogas energy from renewable energies. The main purpose of this study is to calculate the biogas potential that can be obtained from animal wastes. The energy potential to be obtained from cattle, sheep and poultry wastes in the Tekirdağ city has been determined.

According to research, It is possible to obtain 33 million m^3 biogas production per year from animal waste in Tekirdağ and 155 million kWh of electricity energy or 124 million kWh heat energy can be obtained from this amount of biogas.

Keywords Animal waste, Manure, Biogas, Renewable energy, Tekırdag

Introduction

Biogas is the result of fermentation of organic materials. The composition of biogas generally contains 60-70% methane, 30-40% CO_2, and less sulfur, hydrogen, nitrogen, hydrogen and carbon monoxide [7]. Biogas is seen as an alternative energy, especially in the solution of energy need for rural areas. Biogas provides both energy recovery and more efficient fertilization. In our country animal wastes are mostly used as fertilizer in agricultural lands. Manure cleaned from the barn is generally stored outdoors. This leads to reduced nutrient content and increased environmental pollution.

Despite producing 50-65 MTEP (million tonnes of equivalent petroleum) agricultural waste and 11.05 MTEP animal waste per year in Turkey, only 60% of these produced wastes can be used for energy production. It is known that this energy is equal to 22-27% of Turkey's annual energy consumption [6]. In our country there is 1.5 MTEP of energy potential which can be obtained annually from only animal wastes.

Turkey's primary energy demand was 77.04 MTEP in 2001, while energy production was 26.3 MTEP. The energy demand is estimated to be 298.4 MTEP in 2020, while energy production is expected to reach 70.2 MTEP and energy imports to reach 76%.

The main objective of this study is to calculate the biogas potential from animal wastes for the Tekirdag city.

Material and Method

Material

The province of Tekirdag is located between 40° 36 'and 41° 31' north latitude and between 26° 43 'and 28° 08' east longitudes. There are 11 districts and 259 villages in the province.

In this study, Tekirdag Province Food, Agriculture and Livestock Provincial Directorate's 2017 year statistics data were used to determine biogas production and energy potential of Tekirdag province [4].

Methods

The amount of fertilizer obtained from animals varies depending on species. Therefore, acceptances for calculations are used [3]. These are given below.

- 1 cattle animal 3.6 ton / year wet manure,
- 1 small sheep animal 0.7 ton / year wet manure,
- 1 poultry animal 0.022 tons/year wet manure.

According to these;

- 33 m^3/ year biogas from a ton of cattle manure,
- 58 m^3/ year biogas from a tonne sheep's manure,
- It has been determined that 78m^3 / year biogas is produced from a tone of poultry [5] [2].

The amount of heat provided by 1 m^3 of biogas is equal to 0.63 liters of gas oil, 3.47 kg of wood, 4.7 kWh of electricity, 0.43 kg LPG, and 0.8 liters of gasoline [7]. Equivalent energies (gasoline, LPG and electricity energy) of the potential biogas production are calculated. Total heat energy equivalents are calculated.

Result and Discussion

Tekirdag province and districts' animal existence is given in table 1. There are a total of 1233756 animals in the province of Tekirdag.

Table 1: Tekırdag province and districts' animal existence

Districts	Bovine	Ovine	Poultry	Total	%
Çerkezköy	3.112	12.869	2.135	18.116	2
Çorlu	4.658	15.680	83.020	103.358	9
Ergene	9.430	21.910	391.320	422.660	34
Hayrabolu	35.752	31.860	57.500	125.112	10
Kapaklı	5.266	13.310	9.990	28.566	2
Malkara	55.771	77.177	31.130	164.078	13
M.Ereğlisi	3.851	8.803	25.335	37.989	3
Muratlı	8.739	16.093	112.169	137.001	11
Süleymanpaşa	17.185	36.452	43.704	97.341	8
Saray	12.415	21.948	5.830	40.193	3
Şarköy	8.255	43.176	7.911	59.342	5
Total	164.434	299.278	770.044	1.233.756	100

These animals consist of 64% poultry, 24% ovine and the remaining 13% is bovine animal. The largest number of animals are found in Ergene (34%), Malkara (13%) and Muratlı (11%) districts, respectively. The distribution ratios of animal species according to the provinces are given in Table 2.

Table 2: The distribution ratios of animal species according to the provinces (%)

Districts	Bovine	Ovine	Poultry
Çerkezköy	2	4	-
Çorlu	3	5	11
Ergene	6	7	51
Hayrabolu	22	11	7
Kapaklı	3	5	1
Malkara	34	26	4
M.Ereğlisi	2	3	3
Muratlı	5	5	15
Süleymanpaşa	10	12	6
Saray	8	7	1
Şarköy	5	15	1

When we look at the distribution of animal species, While Malkara has the largest share in bovine (34%) and ovine species (26%), Ergene has the largest share in poultry (51%) species. The distribution ratios of livestock enterprises according to the presence of animal numbers are shown in Table 3.

Table 3: The distribution ratios of livestock enterprises

Animal numbers	1-10	11-50	51-100	101-500	500>
Enterprises	6225	3955	267	92	10
%	59.01	37.49	2.53	0.87	0.09

As Table 3 shows, most of the enterprises are small-scale enterprises (59%). This situation, negatively affects the construction and use of biogas in the region. Tekırdag's animal waste potential according to the provinces are given in Table 4 and Figure 1.

Table 4: Tekırdag's animal waste potential

District	Bovine	Ovine	Poultry	Total
Süleymanpaşa	61.866	25.516	961,488	88343
Çerkezköy	11.203	9.008	46,97	20258
Çorlu	16.768	10.976	1.826,44	29570
Ergene	33.948	15.337	8.609,04	57894
Hayrabolu	128.707	22.302	1.265	152274
Kapaklı	18.957	9.317	219,78	28494
Malkara	200.775	54.023	684,86	255483
M.Ereğlisi	13.863	6.162	557,37	20582
Muratlı	31.460	11.265	2.467,718	45192
Saray	44.694	15.363	128,26	60185
Şarköy	29.718	30.223	174,042	60115
Total	591.959	209.492	18.514	819.965

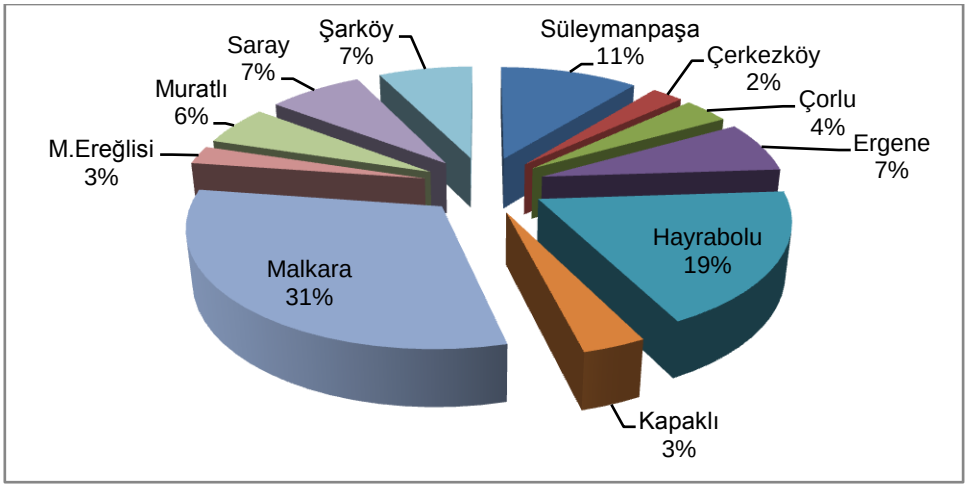


Figure 1: Distribution of potential animal wastes according to districts

Animal waste potential in Tekırdag is 819.965 ton/year. Animal waste potential is highest in Malkara with 31%, Hayrabolu with 19% and Süleymanpaşa with 11% districts respectively. The largest portion of animal wastes constitutes bovine waste by 72%. Tekırdag's producible biogas amount have been given in Table 5.

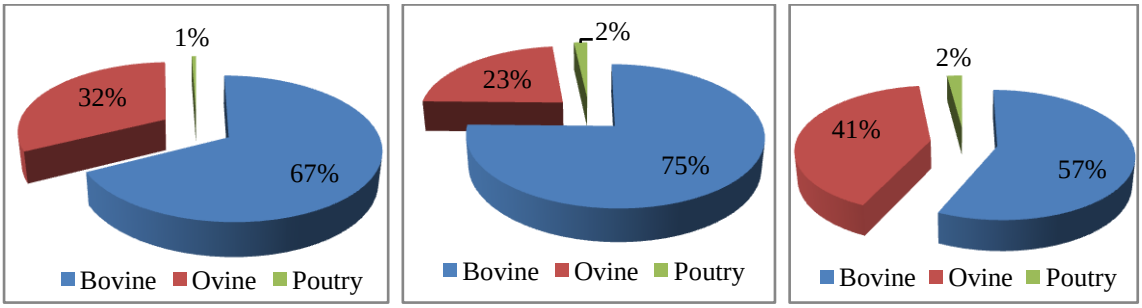
Table 4: Potential biogas amount

Districts	Bovine	Ovine	Poutry	Total	%
Süleymanpaşa	2.041,6	1.479,9	74,9	3.596,5	11
Çerkezköy	369,7	522,5	3,6	895,8	3
Çorlu	553,3	636,6	142,5	1.332,4	4
Ergene	1.120,3	889,5	671,5	2.681,2	8
Hayrabolu	4.247,3	1.293,5	98,7	5.639,5	17

Kapaklı	625,6	540,4	17,2	1.183,1	3
Malkara	6.625,6	3.133,3	53,4	9.812,3	30
M.Ereğlisi	457,5	357,4	43,4	858,3	3
Muratlı	1.038,2	653,4	192,4	1883,9	6
Saray	1.474,9	891,0	10,0	2.375,9	7
Şarköy	980,7	1.752,9	13,5	2.747,1	8
Toplam	19.534,7	12.150	1.321	33.006	100

Tekirdağ's biogas production capacity is estimated at 33 million m^3/year. The largest proportion in production is in Malkara with 30%. Hayrabolu is in the second place with 17%. The total power capacity of the plant for electrical energy that can be installed in Tekirdag is calculated as 13 MW. The power of the plant was proposed as 5 MW for Malkara, 2.5 MW for Hayrabolu and 2 MW for the Süleymanpaşa (central district). [1].

Three districts with the highest biogas production potential are shown in Figure 2. The largest part of the biogas produced is obtained from the bovine species. According to the results, the biogas plant in the region is primarily proposed for the Malkara district. Production potential is estimated to be 9.8 million m^3 per year in Malkara. Other energy sources where the generated biogas energy potential is equal are given in Table 5.



(a) (b) (c)

Figure 2: Three districts with the highest biogas production potential; (a) Malkara, (b) Hayrabolu, (c) Süleymanpaşa

Table 5: The equivalent of the producible biogas in Tekırdag

District	Electricty (kWh)	Gasoline (L)	LPG (kg)	Coal (kg)	Heat energy (kWh)
Süleymanpaşa	16904	2877	1546	4496	13523
Çerkezköy	4210	717	385	1120	3368
Çorlu	6262	1066	573	1666	5009
Ergene	12602	2145	1153	3352	10081
Hayrabolu	26506	4512	2425	7049	21205
Kapaklı	5561	946	509	1479	4449
Malkara	46118	7850	4219	12265	36894
M.Ereğlisi	4034	687	369	1073	3227
Muratlı	8854	1507	810	2355	7083
Saray	11167	1901	1022	2970	8934
Şarköy	12911	2198	1181	3434	10328
Total	155.128	26.405	14.193	41.258	124.101

Biogas production potential from animal waste in Tekırdag in total are approximately equal to 26 million litre gasolines, 14 million kilogram LPG, 41 million kilogram coal, 124 million kWh heat energy and 155 million kWh electricity energy. According to these results, it is suggested to construct a biogas production plant from animal wastes for Malkara province.

Conclusion

Biogas can be an important alternative energy sources in Turkey. Recent years have demonstrated a tendency for growth of biogas production in Turkey, though it is not sufficient. It is important to increase the amount of renewable energy in energy consumption.

Tekırdag city has 0.9% of the biogas production potential in Turkey. Tekirdağ's biogas production potential is calculated at 33 million m^3/year. In the Tekirdağ city, which is in the industrial region and where electricity consumption is intense, 30% of electricity consumption can be covered with animal waste.

Reference

[1]. Aktas T, Özer B, Soyak G, Ertürk M.C, 2015. Determination of The Electricity Generation Potential from Animal Biogas in Tekirdag City. *Journal of Agricultural Machinery Science*. 2015, 11(1), 69-74.

[2]. Altıkat S, Celik A, 2012. Biogas Potential from Animal Waste of Iğdır Province. *Iğdır Univ. J. Inst. Sci. & Tech.* 2(1): 61-66, 2012.

[3]. Eryılmaz T, Yeşilyurt M.K, Gökdoğan O, Yumak B., 2015. Determination of Biogas Potential from Animal Waste in Turkey: A Case Study for Yozgat Province. *European Journal of Science and Technology.* Vol. 2, No. 4, pp. 106-111, June 2015

[4]. Republıc of Turkey Ministry of Food, Agriculture and Livestock. 2017. Tekırdağ Directorate of Provincial Food Agriculture and Livestock, 2017 Agriculture Report, 2017.

[5]. Kaya D, Çankakılıc F, Dikeç S, Baban A, Güneş K, 2005. Evaluation Guide of Agricultural Waste in Turkey. LIFE 03 TCY/TR/000061 Project Report, Tübitak. Turkey.

[6]. Koçer N, Öner C. & Sugözü İ. 2006. Castle-dealing Potential of Turkey and Biogas Production. Fırat University, Eastern Anatolia Research Center, Eastern Anatolia Research, 17-20, Elazığ.

[7]. Yaldız O. 2004. Biogas Technology Course Book. Akdeniz University Publications, Number: 78, p. 181, Antalya, Turkey.